SOIL SURVEY OF CASS COUNTY, MICHIGAN

By W. J. GEIB.

DESCRIPTION OF THE AREA.

Cass County lies in the southwestern corner of the lower peninsula of Michigan, approximately between 41° 40′ 5″ and 42° 7′ north latitude and 85° 45′ and 86° 16′ west longitude. The county is bounded on the north by Van Buren County, on the east by St.

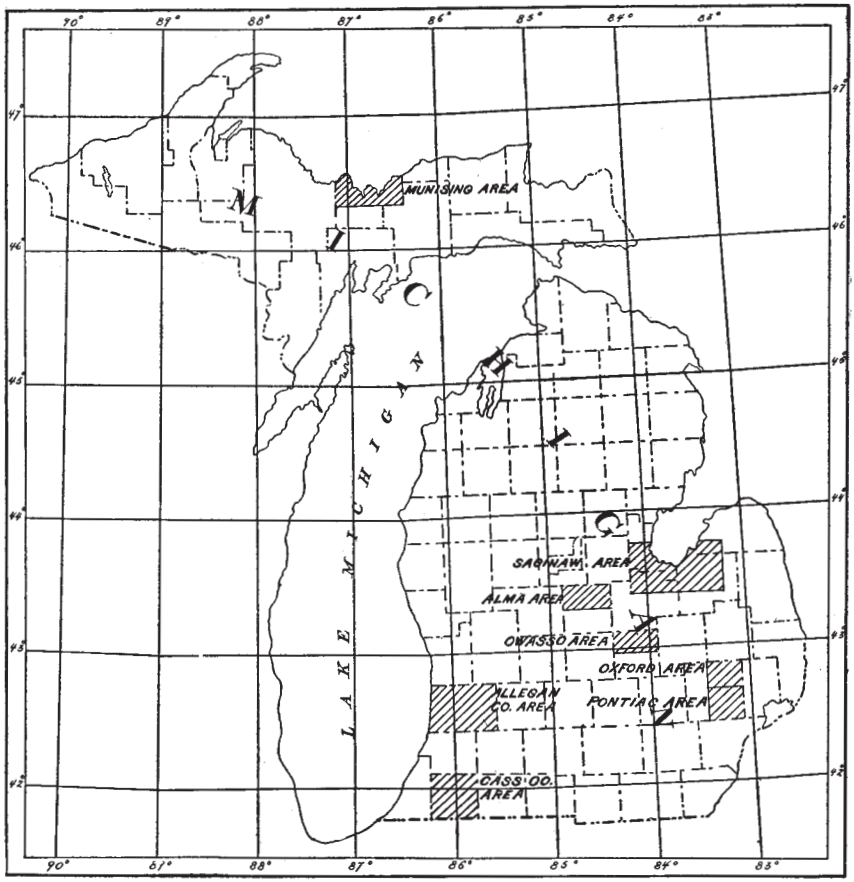

FIG. 25.—Sketch map showing location of the Cass County area, Michigan.

Joseph County, on the west by Berrien County, and on the south by the State of Indiana. Were the southern townships entire the county would be square, measuring 24 miles on each side, but the four southern divisions are only a little more than half townships, and the

area is further reduced by the detachment of nearly 3 square miles lying east of the St. Joseph River. The land area of the county is 320,128 acres, or approximately 500 square miles. The many lakes scattered over the county would bring the total area close to 520 square miles.

The surface features of the county are characteristic of a glacial region. The topography is for the most part undulating or gently rolling, though some of the prairies are level. The most marked elevations are the moraines which traverse the county, extending usually in a northeast and southwest direction. The most extensive and irregular of these is in Newberg Township, occupying the greater part of this township and extending in a northeastern direction into St. Joseph County. The highest point is reached in section 16, where an elevation of 1,100 feet above sea level is attained, or 350 feet above the lowest contour in the area. The slopes throughout this morainic belt are often too steep to be cultivated. For several miles on each side of Glenwood the main line of the Michigan Central Railroad runs parallel with, but a little to the northwest of, another, though less pronounced, moraine. A broken range of comparatively low hills extends to the southwest from Cassopolis, passing through Jefferson Township, the southeastern part of Howard Township, and terminating in the northern part of Milton Township. Another strip of broken country is found to the north of Baldwins Lake, in Porter Township, and a small range of hills also extends across the central part of Calvin Township from east to west.

The chief water courses of the county are Christian Creek and the north and south branches of Dowagiac Creek. Christian Creek rises in Penn Township, flows in a southwesterly direction, and leaves the county about midway of its southern boundary. The north branch of Dowagiac Creek rises in Van Buren County and enters Cass County near the center of the north line of Wayne Township. Its general course is southwesterly, flowing across the northwestern corner of the county and passing out of it about midway of its western boundary. The stream is sluggish and of little consequence as a source of mill power. The south branch flows quite rapidly and affords valuable water power. It has its source in Marcellus Township, flows in a southwesterly direction as far as Mill Pond, and thence in a general westerly direction to its junction with the north branch, about $2\frac{1}{2}$ miles west of the township of Dowagiac. The drainage of the entire county is into the St. Joseph River, which, in addition to the streams described, receives the waters of two smaller tributaries—Rock Creek and Mud Creek—which rise in Cass County.

The first visit of a white man to what is now Cass County, was made in 1813. The first permanent settlement was made in Pokagon Township in 1825. La Grange and Penn townships were soon after-

wards settled. Cass County was created by act of the legislative council of the Territory of Michigan in 1829. The boundaries remained unchanged until 1831, when that part of the county lying east of the St. Joseph River was included in St. Joseph County. Since that time no alterations have been made in the boundaries of the county.

The Chicago road, between Chicago and Detroit, which was laid out along the old Chicago Indian trail, was the first important thoroughfare of the whites through southern Michigan, and it was over this highway that many of the Cass County pioneers came. This road was the main line of travel from East to West until about 1850, when it was superseded by the railroad. It still remains as originally laid out, but is used only for local travel. The early settlers came chiefly from Ohio and Indiana, and many of them were Quakers from Pennsylvania and Virginia stock. They were a thrifty, energetic people, and it was largely through their efforts that Cass County developed into one of the leading counties of southern Michigan. The population in 1830, was 919; in 1850, 10,907; in 1870, 28,096; in 1880, 22,008. From this date until the present time there has been a slight decrease, the census of 1900 giving a population of 20,876, which is evenly distributed throughout the area.

Dowagiac, a manufacturing town which has a grain-drill factory and stove works, has a population of 5,000 and is the largest town in the county. Cassopolis, the county seat, with a population of 1,500, is situated almost in the center of the county, at the intersection of the Grand Trunk Railway and a branch of the Michigan Central Railroad. Marcellus, a town of about 1,300 inhabitants, is located on the Grand Trunk Railway, in the northeastern part of the county, in the center of a very prosperous farming community. Edwardsburg, Penn, Wakelee, and Pokagon are villages of less importance and are all distributing centers for farm machinery, seeds, and general supplies.

The county has an excellent system of transportation. The main line of the Grand Trunk Railway system passes through the county from northeast to southwest, intersecting at Cassopolis a line of the Michigan Central Railroad, which crosses the county from east to west. The main line of the Michigan Central passes through the northwestern section of the county, while the southwestern corner is traversed by a branch of the Cleveland, Cincinnati, Chicago and St. Louis Railway.

The county has ready and accessible markets for all the products of the farm. Chicago is but 122 miles from Cassopolis, via the Grand Trunk Railway, and 105 miles from Dowagiac, via the Michigan Central Railroad. South Bend, Ind., is but 10 miles from the

southern border of the county. The towns within the area afford a local market for a limited quantity of produce.

CLIMATE.

The following table, compiled from records of the Weather Bureau stations at Cassopolis and Wasepi, shows the normal monthly and annual temperature and precipitation. Cassopolis lies almost in the center of the area surveyed, while Wasepi is located a few miles east of the center of St. Joseph County.

Normal monthly and annual temperature and precipitation.

Month.	Cassopolis.[a]		Wasepi.		Month.	Cassopolis.[a]		Wasepi.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° *F.*	*In.*	° *F.*	*In.*		° *F.*	*In.*	° *F.*	*In.*
January	16.7	3.71	24.1	2.37	August	68.6	4.20	69.0	2.84
February	15.3	2.71	21.3	2.56	September	64.8	3.80	62.9	2.71
March	33.4	6.04	36.2	3.37	October	49.4	3.00	53.7	3.00
April	41.2	2.20	46.9	2.01	November	40.4	.10	38.4	3.04
May	59.9	2.70	58.8	2.17	December	22.8	1.21	25.1	2.67
June	67.6	.90	66.0	3.84	Year	46.0	32.97	47.9	34.65
July	71.9	2.40	72.1	4.07					

[a] The monthly and annual temperature and precipitation for Cassopolis are for one year only (1904).

In the table below are given the dates of the last killing frosts in spring and the first in fall. The average dates for Cassopolis are April 29 and October 12, giving a growing season of about one hundred and sixty-six days for the most tender crops.

Dates of first and last killing frosts.

Year.	Cassopolis.		Wasepi.		Year.	Cassopolis.		Wasepi.	
	Last in spring.	First in fall.	Last in spring.	First in fall.		Last in spring.	First in fall.	Last in spring.	First in fall.
1900	.....	.....	May 22	Oct. 17	1903	May 1	Oct. 24	May 1	Oct. 24
1901	Apr. 20	Oct. 5	Apr. 20	Oct. 3	1904	May 16	Oct. 3	Apr. 22	Sept. 22
1902	Apr. 20	Oct. 17	Apr. 20	Oct. 19	Average	Apr. 29	Oct. 12	Apr. 29	Oct. 11

AGRICULTURE.

The oldest settled sections of Cass County have been under cultivation for about eighty years. The early settlers recognized three distinct kinds of soil. The black prairie soil was considered the most productive, and after a long period of cultivation it is still a rich soil and yields good crops. The heavy timber land was considered a good soil, though difficult to clear. The "openings" were considered poor, and much prejudice existed in the minds of the settlers against this kind of soil, but it has since been demonstrated that this is equal to land that was considered of better quality.

The first farms were taken up on the prairies, for these required

less labor to bring under cultivation than the lands covered with heavy timber. The original prairie sod was very tough and required a strong team and a heavy plow to break it up. The first plowing was not usually over 4 inches deep, or just deep enough to get below the grass roots, and the furrows were thrown up into "kinks" to give the elements a chance to hasten the decay of the sod. Corn was planted the first season between the furrows, and given no further attention until harvesting, and frequently yielded from 40 to 60 bushels per acre. When preparing for wheat, the sod was broken in the spring and allowed to lie until sowing time, when the grain was sown broadcast and harrowed in.

The labor of clearing the timbered land was very great. The heavy forests required to be chopped down, cut up, logged, and burned. After this land was cleared, however, cultivation was comparatively easy.

The "openings" presented the appearance of an immense plain. The practice of the Indians was to burn the land over every fall, which had the effect not only of keeping the annual vegetation burned off but the young tree growth also. The "grubs" thus formed grew laterally into stools, the tops of which were hardly perceptible among the prairie grasses. When the land was broken it required a team of from 4 to 9 yoke of oxen and a plow of corresponding strength. After breaking, it was an easy matter to bring the land under cultivation.

General farming has been practiced through the county since its earliest settlement, although wheat was grown more extensively than any other crop until about twenty years ago. It was often grown upon the same field year after year, and it is said that on the prairie soils, which have been under cultivation for a longer period than any other soils of the country, one-half of the crops removed have been wheat. Although this is a very "exhaustive" practice, the prairie soils have maintained their productiveness remarkably well. At first the hay crop consisted only of the wild grasses which grew abundantly on the prairies and in the low marshy places, but later clover and timothy were seeded with wheat.

This method of seeding for hay is the one that has been most extensively followed in the county, but in late years difficulty has been experienced in securing a good stand. These failures have led to different methods, which have met with varying degrees of success. The grass seed is sometimes sown broadcast upon the wheat in the spring and harrowed in. This usually insures a catch of clover and an increased yield of wheat. Another method is to sow the grass seed in August on a well-prepared field, without a nurse crop.

Great improvements have been made in the cultivation of the

soil over the methods practiced by the earlier settlers. Formerly but little attention was given a crop after planting, but now it is recognized that frequent cultivation, besides keeping down the weeds, greatly assists in conserving the soil moisture and helps to carry crops over long-continued dry spells. The depth of plowing is now varied from year to year on the heavier soils to prevent the formation of plow sole, and fields are not allowed to remain idle any longer than can be helped, a crop of rye often being sown to keep the ground covered. The most improved machinery is now used in the cultivation of the soil and in the harvesting of the crops.

During the first twenty-five years in the history of the county, or until the advent of the railroad, inadequate transportation facilities greatly retarded development along all lines. The first wagon roads were mere trails, and it was with difficulty that even small loads could be hauled over them. The section of the main line of the Michigan Central Railroad which passes through Cass County was completed in 1850. Following this the development of all industries was very great. The population increased over 7,000 from 1850 to 1860, the most rapid growth during any decade in the history of the area.

Insect pests have done considerable damage to crops at various times. About fifteen years ago the grasshoppers were very numerous, and for several seasons destroyed the clover crop. The Hessian fly has frequently damaged the wheat crop, and it is still a source of some loss each year.

Stock raising has been an important industry in Cass County for the last fifty years. Large numbers of young cattle are fattened each year and sold to local dealers, who ship them to Buffalo or Chicago. Until a few years ago many sheep were raised, but as more of the land was put under cultivation, sheep seem to have gone out of favor. Large numbers of hogs are raised each year, and the number is constantly increasing because of the increased production of corn. Dairy farming is coming into greater favor, and the growth of this industry should be encouraged, as it offers one of the best means for building up and maintaining the productiveness of the soil. Silos are used to some extent, there being about 50 in the county, and more are being constructed each year. Several creameries are in operation throughout the county. Those under individual ownership are said to be more satisfactory than those worked cooperatively. A considerable amount of milk and cream is disposed of in the towns and villages within the area.

The acreage of corn is increasing each year and more care is being taken in the selection of seed and cultivation of crops. The quantity of wheat grown is decreasing, as it can no longer be produced profitably on account of decreased yields and the keen competition of the

Northwest. Oats are grown on all soils of the county, but not much of the crop is sold, most of it being fed to stock. While potatoes are well adapted to the light soils of the area, the supply grown does not exceed the home demand. A few years ago sugar beets were grown to a limited extent, but the results were not satisfactory. The mint industry has been developed within the last twenty years, and hundreds of acres of swamp land have been reclaimed for the growing of this profitable crop. Peaches have been grown to a small extent for the last twenty years and, while some of the lighter soils on the higher elevations are fairly well adapted to the production of this fruit, the climatic conditions are not as favorable here as in the counties bordering Lake Michigan. Apples are not grown on a commercial scale, though almost every farm supports a few trees of the leading varieties. The grape industry has attained considerable proportions in the northern half of the county, and is growing rapidly. Lawton, the grape center of Michigan, is located 12 miles north of Marcellus, and from this as a starting point grape growing has been pushing farther into the surrounding country each year. Not until within the last six or eight years, however, has the industry reached a commercial scale within the area. From the vicinity of Marcellus the first crop of 30 carloads was shipped during the season of 1905. All grapes are sold through a fruit growers' association, which seems to give entire satisfaction. While most of the vineyards have been comparatively free from fungous diseases, a few have been attacked by black rot and this season's crop ruined. As this section becomes older, this and other diseases will spread and work havoc unless checked by proper methods of spraying.[a]

The adaptation of soils to crops has been given considerable study by the farmers of Cass County. It is recognized that the prairie soils are better adapted to grass and grain crops than to corn, yet it is necessary to grow all of these crops on the same soil, since most of the farms on the prairies have but one soil type. Likewise the heavily timbered soil is considered the best corn soil. The light sandy soils are known to be well fitted to truck farming, small fruits, and berries, yet these industries can not well be developed on account of the scarcity of labor. The reclaimed swamp lands are admirably adapted to the growth of mint, and this industry is confined almost entirely to this soil.

The rotation of crops most extensively practiced throughout the county is as follows: Sod is plowed in the spring and planted to corn. The next season oats are sown, and this is followed by wheat, clover and timothy usually being seeded with the wheat, and hay is grown for one or two years. This gives a four or five year rotation. Rye sometimes takes the place of wheat, and when cowpeas

[a] See Farmers' Bul. No. 156. The Home Vineyard.

or beans are grown they usually follow wheat. Rape is frequently grown as pasture for sheep, and may be introduced into the rotation wherever convenient. Potatoes sometimes follow grass, and grass is sometimes followed by wheat, in which case seeding is done with the oat crop. The agricultural methods in vogue at the present time are well adapted to the conditions as they exist through the county.

The labor question is one of the most difficult problems with which the farmers have to deal. A great many of the young men leave the farm for the shops and offices in the city and there are not enough left to supply the demand; therefore wages are high and the quality of labor often unsatisfactory. The farm hand is usually engaged for seven or eight months and is paid an average of $25 a month and board. It is often stipulated that the laborer's driving horse shall be kept in addition. During haying and harvest time extra men are required and are paid from $1.50 to $2 a day with board. Because of the scarcity of labor the farmers practice extensive rather than intensive farming, the farmer located on the lighter soils being obliged to grow general farm crops when the soils are much better adapted to truck crops.

According to the Michigan census of 1904 there are 2,446 farms in Cass County, 75 per cent of which are operated by their owners, 2 per cent are operated by share tenants, while only 43 farms are rented on a cash basis. One hundred and seventy farms are operated by colored people, and 112 of these are in Calvin Township. When the share system is followed the landlord receives half the crop.

The large increase in the number of owners of farms in the last few years and the decrease in the number of tenants is an encouraging sign. Conditions are such at the present time that tenants who are industrious and economical are soon able to possess farms of their own. The average-sized farm is 119 acres, though they vary from 40 to 320 acres. The average size is being reduced because labor can not be secured to handle a large acreage.

There are in the county 320,128 acres of land, exclusive of the lakes. The Michigan census of 1904 states that 290,180 acres are in farms and that 76 per cent of this land is improved. The total value of all farm property in the county amounts to $12,679,349. The value of the land in farms varies according to location and the character of the soil. The prairie lands sell from $75 to $100 per acre, the heavily timbered soil from $40 to $80 an acre, while the lighter soils range from $15 to $40 an acre.

The farmers are in a prosperous condition and the farm buildings throughout the county are large, well constructed, and as a rule in good repair. This prosperity is especially noticeable on the heavier soils. At the same time it is evident that the soils of Cass County are not producing to their fullest capacity. Their productiveness can

be improved by a better system of fertilization and more thorough cultivation. Considerable quantities of manure are wasted each year by being thrown into a pile in the barnyard and allowed to remain there for a long time. Arrangements should be made to haul the manure to the field and spread it as rapidly as produced. The supply of stable manure falls far short of the needs of the soil, and this lack should be compensated by green manuring. Cowpeas, clover, and buckwheat form excellent green manures, and, while these are now used to some extent, the practice is not as common as it should be.

SOILS.

The soils of Cass County have been derived from a mantle of glacial till which covers the county to a great depth. This glacial material has been modified to a greater or less extent by erosion, the action of the wind, and the growth and decay of vegetation. The glacier which traversed this region moved from northeast to southwest, and practically all the ranges of hills, the courses of streams, and the various soil types have a tendency to follow lines parallel with this course.

The underlying rocks have been covered to a depth of from a hundred to several hundred feet by the glacial débris and have had no influence on the formation of the surface soils. This glacial material, which was originally derived largely from the breaking down of metamorphic and igneous rocks, was transported often over great distances by the glaciers, modified by the action of water, and deposited either in the form of moraines or as nearly level stretches of land.

To the assorting power of water may be attributed, to a large degree at least, the variation in the size of soil grains in the different parts of the county. In swift currents only the heavy, coarse material is deposited; in the more slowly moving streams finer particles settle to the bottom, while the finest particles, forming silt and clay, will not settle until the water is almost or quite still. It will be noted from the map that the heavy soils of this area are confined chiefly to the eastern half of the county, while sands and sandy loams of varying texture occupy the western half. These sandy soils represent areas where the glacial material has been more or less reworked by water. The finest grade of sand is still undergoing slight changes by the action of the wind.

One peculiarity of topography developed by the glacier is seen in the depressed areas and kettleholes which form innumerable lakes, swamps, and muck areas. The lakes, which are generally small, are scattered throughout the area, and the areas of muck and peat mark the beds of former lakes.

Three distinct yet closely related series of soils have been recognized in the present survey. While these were originally derived from the same material, weathering and other forces have developed in each certain characteristics which are readily distinguished. In the Miami series, which is the most extensive in the area, seven types were mapped. The material of this series consists of light-colored glacial débris, which contains a comparatively small percentage of organic matter. The Marshall series, which contains a large percentage of organic matter, giving it a dark-brown or black color, is represented in this survey by but one type. The Clyde series, consisting of glacial lake deposits, is also represented by but one type, of small extent.

The soils of Cass County are representative of an extensive region in Michigan, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, and adjoining States. Roughly speaking, the Miami soils are confined to the sections of country originally covered with timber, the Marshall soils to the prairie sections, and the Clyde series to the beds of old glacial lakes.

Eleven soil types, including Muck and Meadow, have been mapped in the area. The following table shows the actual and relative extent of each:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami loam	103,296	32.3	Meadow	3,648	1.1
Miami sandy loam	80,256	25.1	Miami stony loam	3,520	1.1
Miami sand	65,600	20.5	Miami fine sandy loam	2,048	.6
Muck	22,080	6.9	Clyde sand	896	.3
Marshall loam	20,544	6.4	Total	320,128	
Miami gravelly sandy loam	11,456	3.6			
Miami fine sand	6,784	2.1			

MARSHALL LOAM.

The soil of the Marshall loam consists of a black or dark-brown loam from 12 to 16 inches deep. The characteristic color is black, the dark brown occurring only where this type grades into other soils and in a few small areas where the material is of a coarser texture than usual. There is sometimes present a high percentage of silt which imparts to the soil a smooth feel. In other places considerable of the coarser grades of sand are present making the soil rather gritty. A few stones sometimes occur on the surface along the borders of this soil, but, as a rule, it is freer from stones than the remainder of the area. The subsoil to a depth of 36 inches consists of a brown or dark-brown heavy loam or clay loam. At about 24 inches it contains a small quantity of coarse sand and fine gravel, and is

gritty. The entire type is underlain at no great depth by beds of sand and gravel, and these are frequently encountered at 36 inches. During dry seasons the subsoil becomes very hard and is spoken of as "hardpan." While the Marshall loam is more uniform in texture, color, and depth of soil than any other type in the area, there are small patches which are inferior in crop production to the adjoining soils, which so far as a superficial examination shows are the same. In such patches the underlying sand and gravel is usually found nearer the surface, sometimes being encountered at from 22 to 24 inches.

The Marshall loam is an easy soil to cultivate. If plowed when comparatively dry, which is the most favorable time, there is no difficulty in securing a mellow seed bed, but if plowed when wet and allowed to dry out in the furrow, large clods are formed. These pulverize easily, however, under the roller immediately after a light rain, and after harrowing twice the soil is in good physical condition.

The Marshall loam occurs scattered over the county and occupies the greater part of the "prairies," which vary in extent from one-half square mile to 9 square miles. The largest of these lies in Penn township northeast of Cassopolis, and is known as Youngs Prairie. All things considered, this is without doubt the finest agricultural section in Cass County. Another area of Marshall loam of nearly the same size lies immediately southwest of Edwardsburg, in Milton and Ontwa townships. An area of smaller extent occupies the center of La Grange Township. In the north half of Volinia Township is a long, narrow strip, extending from northeast to southwest, which has somewhat the appearance of an ancient valley. Other smaller areas are found in various parts of the county.

The surface of the Marshall loam varies from level to undulating or gently rolling. On account of the underlying sand and gravel the natural drainage is very good and it is not necessary to resort to artificial drainage. Where the clay loam subsoil extends to an unusual depth underdrainage would be beneficial, but it is not practiced.

The Marshall loam is of glacial origin, being derived directly from the glacial till, which everywhere covers the county to a great depth. In some places this soil occupies a lower level than the surrounding country or lies adjacent to soils of more broken topography, and has the appearance of occupying old lake beds. In other places, however, there is a gradation into the Miami loam or the Miami sandy loam without the slightest change in elevation. A very heavy growth of wild grass originally covered the prairies, and the dark color of the soil and the large amount of vegetable matter present is due to the decay of this heavy annual growth. When the first settlers came the greater part of the prairies were free from all timber growth. On

Youngs Prairie, however, there was a series of small maple groves extending from northwest to southeast and reaching the borders of the more densely timbered land.

The Marshall loam is devoted entirely to general farming and stock raising. Corn, oats, wheat, and hay are the principal crops. Wheat is not grown as extensively as in earlier days. It was formerly grown almost continuously on the same field, with the result that the yields have been greatly reduced. Yields of 45 bushels of wheat per acre have been secured from this type, while of late the yield has fallen as low as 10 bushels per acre, with 22 bushels as a fair average for the type. Corn yields from 45 to 75 bushels, with an average of 50 bushels; oats from 40 to 60, with an average of 45 bushels, and hay about 2 tons per acre.

The soil is usually plowed to a depth of 6 inches, but the depth is varied frequently to prevent the formation of a "hardpan." No commercial fertilizers are used, but all the stable manure produced is applied to the fields.[a] This is sometimes applied to sod and plowed under, or it may be spread on the plowed surface before harrowing. The growing of cowpeas for green manure should be practiced more, as the supply of stable manure is insufficient.

Very few of the farms on the Marshall loam have passed out of possession of the families which originally settled on them. The price of farms on this type is from $75 to $100 an acre.

The following table shows the average results of mechanical analyses of samples of the Marshall loam.

Mechanical analyses of Marshall loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15315, 15317	Soil	0.8	10.6	10.9	15.9	5.3	34.5	21.4
15316, 15318	Subsoil	1.3	8.6	10.4	20.0	4.4	32.8	22.2

MIAMI LOAM.

The soil of the Miami loam consists of a brown or light-brown loam of medium to fine texture, extending to a depth of from 8 to 10 inches. There is usually present on the surface and mixed with the

[a] In a test by the wire-basket method to determine the manurial needs of this type of soil, the largest increase in plant growth over that obtained from the untreated soil was obtained with stable manure. Nitrate of soda and sulphate of potash applied together also gave a good increase, and a combination of the three fertilizing salts with and without the addition of lime was followed by good results. Lime alone gave but slight increase over the untreated soil. These results, while applying strictly to the field from which the sample was taken, will doubtless apply to much of this type of soil in Cass County.

soil a small quantity of gravel, though areas frequently occur in which the gravel is entirely lacking. Stones and bowlders are frequently seen, though not in sufficient quantity to detract from the farming value of the soil. The subsoil consists of a heavy, yellowish-brown loam or clay loam, which, at a depth of from 24 to 30 inches, contains sufficient coarse sand and fine gravel to impart a gritty feel. In many places the subsoil is sufficiently heavy and there is enough gravel present to permit classing it as a gravelly clay. The entire type is underlain at no great depth by beds of sand and gravel, and these beds are occasionally encountered at a depth of 30 inches. Between the soil and the subsoil proper there is a thin layer of fine sandy or silty material lighter in color than either. Over a part of the county the subsoil grades into bowlder clay. Over these areas the surface is a heavy loam and the beds of sand and gravel are from 5 to 6 feet below the surface. Where the underlying gravel beds are encountered at 30 inches the soil frequently consists of a heavy, sandy loam. These areas are of small extent and have been mapped as a light phase of the Miami loam.

The Miami loam is a comparatively easy soil to cultivate if plowed at the proper time. If plowed when too wet the soil clods badly and the lumps are often difficult to pulverize. The greater proportion of the type, however, works up readily into a mellow seed bed if properly handled.

This type of soil, the most important and extensive in the survey, is confined chiefly to the eastern half of the county. The largest area occupies the southern part of Penn Township, the larger proportion of Calvin and Mason townships, and the central part of Porter Township. Another large area takes up nearly all of Marcellus Township and extends to the southwest, joining the Marshall loam on Youngs Prairie. Another area occurs along the western line of the county in Pokagon and Howard townships. The type is broken throughout by small patches of Miami sandy loam and Muck.

The surface of the Miami loam may be classed as rolling, though it varies from nearly level where it joins the prairie soil to rolling and even hilly in the eastern part of the county. Immediately south of Youngs Prairie and over a part of the type in north Porter Township the surface is level to gently rolling. The roughest phase occurs in Newburg and the south part of Marcellus townships, where it is associated with the Miami stony loam and the Miami gravelly sandy loam.

The natural drainage of this soil is good, owing to the underlying beds of sand and gravel and to the irregularities of the surface. Where the bowlder clay occurs underdrainage would be beneficial, but in these areas underdrainage is not practiced to any extent. Kettleholes are frequently seen throughout the type, and while there

is no surface outlet to these, the water is carried off through the soil and crops are damaged but little in such depressions.

The Miami loam is derived from glacial till, which everywhere covers the county to a great depth. The heavy, gritty subsoil represents the bowlder clay partially mixed with glacial sand and gravel. The roughest areas of the type probably represent morainic material.

The original timber growth on this type consisted chiefly of beech, maple, and oak, with some elm, hickory, and walnut. Where the type borders the prairies the soil by many is considered superior to the Marshall loam and also to the Miami loam as it occurs farther away from the border.

This soil is devoted to general farming. Wheat, oats, corn, and hay, which are the chief crops, are successfully grown. Wheat yields from 12 to 35 bushels per acre with an average of 18 bushels; oats yield from 20 to 50 bushels, with an average of 40 bushels; corn averages 45 bushels, and 1¼ tons is considered an average yield of hay. Rye is sometimes grown and gives an average yield of 18 bushels per acre. Grapes are grown to a considerable extent and the industry is developing rapidly. It is said that soil of this character will produce fruit of a better flavor than that grown on the lighter soils most commonly devoted to grapes.

No commercial fertilizers are used on this type, but all the stable manure is saved and applied to the land.[a] Clover is sometimes plowed under for a green manure, though this practice is not common. Cowpeas, soy beans, and buckwheat are grown to a very limited extent. Inasmuch as the supply of stable manure is deficient, green manuring should be practiced to a greater extent upon this soil. Difficulty is often experienced in securing a good catch of clover, but as cowpeas grow readily upon this type, and as this crop is equally as good as clover for building up a soil and maintaining its productiveness, it is recommended that cowpeas be grown to a greater extent. If it is not desirable to plow under the entire vine, the crop may be cut for hay and the stubble turned under. If the vines are cut for hay and the manure returned to the land, the same fertilizing value will be secured in addition to the feed value. When buckwheat is used as a green manure it should be plowed under

[a] The manurial requirements of this type, as determined by the wire-basket method, are best met by the use of stable manure or the turning under of some green manuring crop, green cowpea vines in particular. The increases from the use of chemical fertilizers, singly and in combination, were slight, the largest occurring where a complete fertilizer was used. Lime seemed to have little, if any, effect. The sample used in these tests was secured from a field that has been under cultivation for eighteen years. Wheat, oats, and corn have been grown constantly with no definite system of alternation. While the results apply to this field particularly, they are no doubt significant for most of this type in the area.

while in blossom. This is not so valuable a fertilizer as cowpeas or clover, but greatly assists in mellowing a heavy soil.

Farms on the Miami loam range in value from $40 to $80 an acre.

The following table shows the average results of mechanical analyses of samples of this type:

Mechanical analyses of Miami loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15303, 15305	Soil	0.9	8.9	11.4	14.8	5.4	42.1	15.8
15304, 15306	Subsoil	1.4	8.4	10.7	15.1	6.0	32.3	25.1

MIAMI SANDY LOAM.

The soil of the Miami sandy loam to an average depth of 10 inches consists of a brown, sandy loam. Where the material is of medium texture, as is usually the case, the soil is comparatively loose and mellow, but where the texture is inclined to be fine the surface is often compact, giving the soil the appearance of being much heavier than it really is. There is present on the surface and mixed with the soil a small quantity of gravel, and a few stones are sometimes seen, though not in sufficient quantities to interfere with cultivation. The subsoil to a depth of 36 inches consists of a light-brown sand grading into a sticky sand or sticky sandy loam at a depth of from 20 to 24 inches. Occasionally the sticky sandy loam is not encountered until a depth of 30 inches is reached, and again the soil grades directly into it at a depth of from 30 to 36 inches.

As a rule this is an easy soil to cultivate. Where the fine material predominates and the surface becomes compact, the soil clods to a slight degree, but the lumps are readily pulverized.

The Miami sandy loam is more evenly distributed throughout the county than any other type, but there are no large unbroken areas. This soil is really a gradation between the Miami loam and the Miami sand, and is therefore subject to considerable variation. It is found closely associated with both types throughout the entire county, occupying broken irregular areas which vary in size from a few acres to several square miles. The largest occurrence of the type is between Pokagon and Cassopolis, extending south to Eagle Lake and occupying the southern part of Pokagon and La Grange and the northern part of Howard and Jefferson townships. Another large area extends from Vandalia to Corey, along the line of the Michigan Central Railroad.

The surface of the Miami sandy loam varies from gently rolling to rolling and hilly. The roughest portion lies in Newberg and Por-

ter townships, the large area to the east of Pokagon is gently rolling, while the strip which extends along the south fork of Dowagiac Creek is comparatively level. Because of the gravel and sand content and the irregularities of the surface the natural drainage is excellent. Artificial drains have never been used in this soil, but there are a few depressed areas which would be benefited by underdrainage.

The Miami sandy loam is derived from the glacial and morainic material which covers the county.

This soil is devoted almost exclusively to general farming, and produces good crops of wheat, corn, oats, hay, rye, beans, and potatoes. The acreage of wheat is being reduced each year and more attention is being paid to corn. Wheat yields from 10 to 22 bushels, with an average of 16 bushels, per acre; corn from 25 to 40 bushels, with an average of 30 bushels, and oats from 25 to 45 bushels, with an average of 35 bushels, per acre. Eighteen bushels per acre is considered a fair crop of rye, while 100 bushels of potatoes is an average yield, and hay yields from three-fourths to 1 ton per acre. Peaches are grown on this soil to some extent, and where the surface is rolling the type is fairly well adapted to this fruit, but the climatic conditions do not seem to be as favorable as they are nearer Lake Michigan. Grapes of good quality are produced on this type, and the industry is growing.

The cultural methods employed on the Miami sandy loam do not differ materially from the methods used on other soils, but less cultivation is required to secure a good seed bed than on the heavier soils of the area. The growing of wheat should be discontinued, as it is no longer profitable on this soil. No commercial fertilizers are used, but all the stable manure produced is utilized. This falls far short of being sufficient, as the fields receive an application of manure no oftener than once in five or six years, and some fields are never manured. Green manuring, which is resorted to only occasionally, should be practiced more extensively. Clover, cowpeas, or buckwheat may be used, though either clover or cowpeas will undoubtedly give better results than buckwheat. Farms on this soil type range from $25 to $50 an acre.

The following table shows the average results of mechanical analyses of fine-earth samples of this type:

Mechanical analyses of Miami sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15291, 15293	Soil	2.7	14.5	14.7	30.9	7.0	19.6	10.1
15292, 15294	Subsoil	.6	8.6	14.4	33.7	8.1	22.3	11.4

MIAMI SAND.

The soil of the Miami sand to a depth of from 6 to 10 inches consists of a brown sand of medium texture. The organic-matter content is usually small, and the soil is loose and open, but where a considerable quantity of vegetable matter is present it imparts to the soil a loamy characteristic. There is often present on the surface and mixed with the soil a small percentage of gravel. This is never more than 10 per cent, and some parts of the type are entirely free from gravel. The subsoil to a depth of 36 inches consists of a yellow, medium-textured sand, frequently becoming coarser with increasing depth. Fine gravel is often found in the subsoil, and a gravel bed may be encountered at a depth of 30 to 36 inches. In a few localities there is sufficient clay present at 30 inches to make the sand slightly sticky. On account of the loose, open character of the soil it is very easy to cultivate.

The largest area of Miami sand occupies the southwestern part of the county in Howard, Jefferson, Milton, and Ontwa townships. Another area of considerable size follows the course of the Michigan Central Railroad from Glenwood to a point 1 mile north of Pokagon. Other smaller areas are scattered throughout the western half of the county. With the exception of a few small patches along the south line of the county and in Porter Township, the eastern half has practically none of this soil.

The surface of this type varies from gently to steeply rolling. The roughest section lies in the southeastern part of Howard and the southwestern part of Jefferson Township. In the western part of Milton Township and about Dowagiac it is only gently rolling. On account of the loose, open character of the soil and subsoil and the irregularities of the surface the natural drainage is very good. The soil suffers considerably from drought during long-continued dry periods.

The Miami sand is a glacial soil derived from the thick mantle of till which covers the county. The more rolling parts of the type are made up largely of morainic material. The individual soil particles are angular, and on close examination numerous grains of feldspar may be seen. These can readily be recognized by their pinkish color. The sand was originally derived from granitic rocks.

Wheat, corn, oats, rye, and potatoes are grown upon this soil. The yields vary greatly, depending upon the topography and the season. On the comparatively level areas yields are good in seasons of sufficient rainfall, corn sometimes producing 40 bushels per acre, but in dry seasons crops suffer greatly, especially where the surface is more rolling. Wheat yields from 8 to 20 bushels, with an average of 14 bushels; corn, from 20 to 40 bushels, with an average of 25 bushels;

oats, from 20 to 45 bushels, with an average of 30 bushels, and hay about three-fourths ton per acre. Potatoes will average 100 bushels per acre in good seasons. Some berries and small fruits are grown. These do exceedingly well, and there is an unlimited market for all that can be grown. Grapes are grown to some extent on this soil, but in quality do not seem to be equal to those produced on the heavier soil.

While general farming is practiced almost exclusively on this type, it is better adapted to truck growing. On account of insufficient labor, however, no large acreage can be devoted to this industry. No commercial fertilizers are used,[a] but stable manure is applied. There is not a sufficient amount of this to maintain the productiveness of the soil, and it should be supplemented by green manure. Cowpeas should be grown more extensively. The crop may be pastured or cut for hay and the stubble plowed under, or the entire vine may be turned under, though it is probably more profitable to feed the vines and return the manure to the field. In a rotation the cowpeas may follow wheat or rye.

Farms on this type vary in value from $15 to $40 an acre, depending on the location.

The following table shows the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Miami sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15309	Soil	1.5	17.3	23.1	40.9	3.7	8.0	5.0
15310	Subsoil	1.5	14.4	21.7	45.3	4.0	8.1	5.2

MIAMI STONY LOAM.

The surface soil of the Miami stony loam to an average depth of 8 inches consists of a fine, light-brown loam. There is present on the surface a large number of stones and bowlders, which greatly interfere with cultivation. Many of these have been picked up and placed in piles about the fields or used in constructing stone fences. A small

[a] A sample of this soil was subjected to tests by the wire-basket method to determine its manurial requirements. The greatest increase followed the use of green cowpeas with lime, the next manure, which was equaled by the best results of combinations of chemical fertilizers. The results show very clearly the importance of adding organic matter to this soil. The sample treated was taken from a field that has been under cultivation for fifty years or more, on which commercial fertilizers had never been used and manure not during the last five years. While the results apply strictly to this field, they are doubtless suggestive for all this type in the county.

quantity of gravel is also mixed with the soil. The subsoil consists of a light-brown loam or a light gritty clay loam to a depth of 36 inches. In a few localities the subsoil is a heavy sandy loam and gravel is frequently encountered at a depth of from 30 to 36 inches. On account of the stones and the irregularities of the surface this type is the most difficult soil in the area to cultivate.

The largest area of Miami stony loam is located in the central part of Newberg Township. Small areas are found throughout the northern part of Penn and Volinia townships. The surface varies from rolling to hilly, parts of it being too steep to cultivate. The uncultivated parts are used largely for pasture. The natural drainage is good because of the uneven surface. This soil is derived chiefly from morainic material.

The Miami stony loam is devoted to general farming, and where the surface is gently rolling yields equal to those secured on the Miami loam are often obtained. On the roughest phases, however, the yields are low. This soil is best adapted to stock raising, and it is advisable to keep as much of it in pasture as possible. The value of farms on this type varies from $15 to $25 an acre.

The following table shows the result of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Miami stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15289	Soil	0.7	4.6	5.6	13.1	14.3	46.1	15.3
15290	Subsoil	1.1	4.3	6.1	17.2	11.9	40.0	18.4

MIAMI GRAVELLY SANDY LOAM.

The soil of the Miami gravelly sandy loam, to an average depth of 8 inches, consists of a brown light sandy loam of medium texture. There is present on the surface and mixed with the soil from 10 to 30 per cent of gravel. Stones and bowlders may also occur on the surface in sufficient numbers to interfere with cultivation. The subsoil to a depth of 36 inches consists of a yellowish light sandy loam with a high gravel content, and a gravel bed is frequently encountered at a depth of 30 inches. Enough clay is often present to make the subsoil slightly sticky. The soil is difficult to cultivate on account of the gravel and stones.

The largest area of this type is found in the eastern part of Newberg Township, extending as far south as the Michigan Central Railroad. Two small areas are found in Volinia Township, and small patches occur in other parts of the county.

The surface of this type is rough and broken, and some areas are

too steep to be cultivated. On account of the irregular surface features and the underlying gravel the natural drainage is good and the soil often suffers from drought.

Though cultivation is difficult, the type is devoted to general farming.[a] It should be devoted more to stock raising, and the roughest areas reserved for pasture lands. Farms on this soil range in value from $15 to $25 an acre.

The following table shows the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Miami gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15299	Soil	6.1	29.0	18.7	23.3	4.1	10.1	8.2
15300	Subsoil	5.6	20.6	14.4	22.9	4.0	11.9	20.1

MIAMI FINE SAND.

The soil of the Miami fine sand to an average depth of 6 inches consists of a brown, loose, and incoherent fine sand. When the surface is not covered by a growing crop and the soil is very dry, as is often the case during July and August, the particles are readily blown by the wind and a few small dunes have been formed in this way. The subsoil to a depth of 36 inches is a yellow, loose, fine sand, sometimes containing fine gravel and underlain by gravel. On account of the loose character of the soil it is very easy to cultivate.

The largest and most important area of this type is located in the center of Wayne Township. Another area about 1 square mile in extent lies in the southern part of Howard Township, and other small areas are scattered through the western half of the county.

The surface of the Miami fine sand is rolling, and this, together with the open character of both soil and subsoil, insures good drainage. Crops often suffer from drought, especially on the areas occupying the tops of small hills and ridges. The soil is of glacial origin, modified to a small extent by wind action.

The only difference between this type and the Miami sand is that it is finer in texture. The conditions as regards yields, crops grown,

[a] Manurial requirements of this soil, as determined by the wire-basket method, seemed to be met by all treatments in which nitrogen was present. Good increases followed the use of a complete fertilizer and a combination of nitrate of soda with acid phosphate ranked next. Stable manure produced a good increase, about equal to that obtained from the use of mineral fertilizers. Of all the treatments, lime alone gave negative results, and its presence undoubtedly prevented the best results being obtained from the use of cowpea vines. The evident need of nitrogen by this soil suggests that the cultivation of the leguminous plants would do much to improve its productiveness.

rotations followed, and methods practiced are the same as on the Miami sand. The same methods will also apply for its improvement.[a]

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Miami fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15313	Soil	0.1	1.2	7.6	74.9	8.6	3.1	4.4
15314	Subsoil	.0	1.4	6.9	74.5	10.0	2.9	4.0

MIAMI FINE SANDY LOAM.

The soil of the Miami fine sandy loam, to an average depth of 12 inches, consists of a brown or light-brown fine sandy loam, usually containing a small percentage of fine gravel. It contains enough clay and silt to cause the surface to become compact when lying idle, thus giving it the appearance of being heavier that it really is. The subsoil to a depth of 36 inches consists of yellowish and somewhat sticky fine sandy loam containing some fine gravel. A gravel bed is sometimes found at 30 inches. When dry and compact the soil is rather difficult to break up, but the clods pulverize readily under the roller and harrow.

The largest area, containing about 1 square mile, is found in the southwestern part of Wayne Township. A few other smaller areas are scattered over the northwestern part of the county. The surface is rolling and the natural drainage good.

This soil resembles the Miami sandy loam, except that it is finer in texture. The crops grown, yields obtained, rotation followed, and methods practiced are the same as on the Miami sandy loam.

The following table shows the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Miami fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15297	Soil	0.3	2.9	3.9	31.1	23.9	26.4	10.8
15298	Subsoil	.3	2.7	3.5	23.9	26.6	25.2	17.2

[a] In a test by the wire-basket method to determine the manurial requirements of this type, the greatest increase was obtained from the use of stable manure, and the next greatest from cowpea vines with lime. While an increased growth followed the use of all mineral fertilizers, whether applied singly or in combination, it was in every case greatly inferior to the increase produced by the first two treatments. The results indicate that the production of humus is an important feature in handling this type of soil.

CLYDE SAND.

The Clyde sand is the only representative of the Clyde series found in the area. The soil consists of a black, loamy sand, with an average depth of 10 inches. The particles are fine to medium in texture, and there is often a very large proportion of organic matter present. The subsoil to a depth of 36 inches consists of a sand of medium to fine texture and of either a light or dark gray color. The soil is easily worked, but is often too wet to be cultivated. It lies adjacent to Muck areas that were formerly old lake beds, and is composed largely of a mixture of the decomposed vegetable matter and the sand found bordering these former lakes.

The largest area mapped lies in the southern part of Howard Township, where it is devoted to peppermint and corn. Fair yields of these crops are obtained.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Clyde sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
15287	Soil	0.2	7.1	31.9	45.6	1.6	6.8	6.8
15288	Subsoil	.0	3.5	27.9	56.4	1.8	6.4	4.2

MEADOW.

The soil known as Meadow is so variable that it could not be classified with any of the recognized types of the area. The surface soil consists of a sandy loam or loam of varying depth, grading usually into sand or gravel, though sometimes the subsoil is a clay loam. No part of the Meadow is under cultivation, and it is doubtful if any of it will ever be reclaimed, as it lies adjacent to stream courses, in low swampy areas, from which sufficient fall can not be obtained to carry off the surface water. The material is largely composed of wash brought down by streams, and the type has no value from an agricultural standpoint.

MUCK.

The Muck consists of an accumulation of decaying vegetable matter in varying stages of decomposition. In the greater part of the areas mapped the material has reached an advanced stage of decomposition and there is mixed with it varying, though small, proportions of earthy material. There are a number of small patches, chiefly occupying old lake beds, in which the material is almost wholly organic matter in the earlier stages of decay. These areas might be classed as peat, but on account of their small extent no attempt has been made to separate them from Muck. The Muck varies in

depth from 1 to 10 feet, is always black and very mellow, and usually is underlain by clay, though frequently sand is encountered. A thin layer of marly material was found in a few instances between the Muck and the clay subsoil.

The largest area of Muck extends along the north fork of Dowagiac Creek, through Wayne and Silver Creek townships. It varies from 1 mile to 2 miles in width and is about 12 miles long. Another area of considerable size lies in Howard and Milton townships. It is about 4 miles long by 1 mile wide. Other small areas of from a few acres to 1 square mile in extent are scattered throughout the county.

Naturally the Muck areas are poorly drained and in a swampy condition, but in many cases they are being reclaimed. The north fork of Dowagiac Creek where it passes through the Muck area in Wayne and Silver Creek townships has been dredged and straightened, and while the project was not as successful as was hoped, a large proportion of the area is sufficiently well drained to be cultivated. A large open ditch has been dug through the Muck area in Howard and Milton townships, and practically all of this is under cultivation. Many of the small patches throughout the county have also been reclaimed.

The Muck is derived from decaying vegetable matter which has grown and died in the old lake beds and in swampy areas adjacent to streams. The wash from the surrounding soils has been mixed to some degree with the vegetable mold, and in a few cases to a sufficient extent to impart a gritty feel.

The areas of Muck [a] which have been reclaimed have been devoted to the growing of peppermint, corn, and hay. Corn does not do well for the first few years, especially if the organic material is not thoroughly decomposed. The old fields produce from 40 to 50 bushels of corn per acre, while the yield of hay is from 1 ton to 2 tons per acre.

The growing of peppermint is confined almost entirely to the reclaimed swamp lands or Muck, though it grows well on the rich upland soils. It is considered a very "exhaustive" crop and should not enter the rotation oftener than once in five or six years on up-

[a] A test to determine the manurial needs of this type was made in the Bureau laboratories, using the wire-basket method. Sulphate of potash used alone gave an increase in plant growth over that obtained in the untreated soil, and was also effective in all combinations into which it entered. In no case, however, was the increase obtained with fertilizers sufficient to make their use profitable. The plants produced on the untreated soil were superior to many of those grown upon soils of other types, even with the most beneficial treatments. The providing of adequate drainage and the maintenance of a good physical condition in this soil will doubtless secure as good results at this time as could be achieved by any method of fertilization.

land soils. It is usually planted in the spring, though some success has been attained by fall planting. The roots for planting are secured from an old field, and after the land has been prepared by plowing and harrowing, trenches from 6 to 8 inches deep and 3 feet apart are made, in which the root stocks are dropped at intervals of a few inches, after which they are covered. After the mint has a start the hardest kind of work commences—that of keeping out the weeds. It is very essential that weeds be kept out the first year, for if they get a start the first season it is almost impossible to keep them out the second, and also because the weeds depreciate the value of the product. Mare's-tail is the most dreaded weed, since it gives off during distillation a volatile oil which is bitter and pungent.

While the plants are small cultivation is carried on the same as for corn, but later it is necessary to weed by hand on account of the rank growth. The second year the plants are allowed to cover the entire ground. Mint is grown upon the same field for a succession of years, though it is plowed up occasionally in the fall and allowed to grow again from the roots the next year.

Harvesting begins the latter part of July and continues until October. The mint is cut with the mowing machine, cured for several hours, raked into cocks, and hauled to the distillery. The distillery is usually situated in or near the field from which the crop is gathered. The typical still is a building about 30 by 40 feet, either with a large door at one side or with an open end into which the loaded wagon is driven. The mint is then thrown into wooden vats, which are hooped with heavy iron bands. These vats are from 5 to 8 feet deep and about 6 feet in diameter and are fitted with a steam-tight cover. The mint is trodden down closely with the feet until the vat is full, when the lid is fastened securely. A pipe enters at the bottom to convey the steam from the boiler, and another from the top of the vat connects with a large coiled pipe over which cold water constantly runs. The steam passing through the mint volatilizes the oil, and this vapor, mixed with the steam, is condensed in the worm. The mixed oil and water is collected in a receiver, where they separate readily by the difference in specific gravity. The oil is stored in cans holding 20 pounds each. Forty pounds is considered a fair yield per acre, and $2.50 a pound is an average price. A large proportion of the product is exported.

The mint hay when taken from the still is dried and sometimes fed to stock, no evil results having been observed from the practice.

Michigan leads in the production of peppermint, and while there are thousands of acres of swamp land which, when drained, will be admirably adapted to this crop, there is danger of overproduction, since there is only a limited demand at present.

SUMMARY.

Cass County is situated in the southwestern corner of the southern peninsula of Michigan, and is the second county east from Lake Michigan. It lies within the glaciated region, and its surface features vary from level to hilly, the greater proportion being gently rolling. The roughest parts consist of a series of moraines extending chiefly from northeast to southwest.

The climatic conditions are variable. The summers are often exceedingly hot, while in the winter the cold is frequently intense. The extremes, however, are of short duration. The rainfall is usually evenly distributed throughout the year, though droughts sometimes occur in July and August.

The natural drainage is excellent, since all of the soils are underlain at from 3 to 8 feet by beds of sand and gravel. The drainage of the entire county is into the St. Joseph River, which bounds the county on the southwest.

The population of the area in 1900 was 20,876, and is evenly distributed over the county. There are 320,128 acres of land in the county, of which approximately 75 per cent is improved.

The principal products are corn, wheat, oats, hay, potatoes, beans, a small amount of truck, peppermint, live stock, and dairy products. In 1904, 1,580,640 bushels of corn were produced. The acreage of this crop is on the increase, while that of wheat is decreasing. Most of the corn and oats are fed to stock. Beans are not grown extensively, and the potatoes and truck grown no more than supply the home demand. Large numbers of cattle and hogs are fattened each year and shipped to Buffalo and Chicago. The dairy industry is growing constantly. The grain which is sold goes to local elevators. The output of the several creameries finds a market chiefly in Chicago, while considerable milk and cream are disposed of in the towns within the area.

The main line of the Michigan Central and one of its branches, together with the Grand Trunk and a branch of the Big Four Railroad, traverse the area and afford excellent transportation facilities for all parts of the county. The wagon roads are chiefly laid out along section lines and are kept in good repair.

The most general rotation of crops practiced is corn, oats, wheat, and grass. Rye sometimes takes the place of wheat, and when clover fails cowpeas are frequently grown. No commercial fertilizers are used, but all stable manure produced is applied. Clover and cowpeas are sometimes used as green manure, but the practice is not common.

On account of the insufficient labor supply it is necessary to practice general farming on the light soils of the county. They are better adapted to truck crops. When engaged by the month, $25 and board

is paid a farm hand; in harvest time from $1.50 to $2 a day is the usual wage.

Eleven soil types were recognized in the survey, representing three distinct series—the Miami, the Marshall, and the Clyde. The types include fine and medium sands and sandy loams, gravelly areas, and loam soils. No clay or clay loam was found. The light sandy soils range in value from $15 to $25 an acre, while the loam soils bring from $80 to $100 an acre.

The Marshall loam is the rich, black soil of the prairies and is considered the best in the county. This type is devoted to general farming and stock raising, and is well adapted to grass and grain crops. The average value of farms on this type is $85 an acre.

The Miami loam is the most extensive soil type in the area and is well adapted to general farming and stock raising. The soil consists of a brown loam which works readily into a mellow seed bed. The Miami loam is better adapted to corn than the other soils of the area. An average price for farms on this type is $50 an acre.

The Miami sandy loam is an extensive type, and, while not equal to the Miami loam in crop value, it is considered a good general farming soil. Thirty-five dollars an acre is the average price for farms on this type.

The Miami sand is well adapted to truck farming, small fruits, and berries, but on account of an insufficient labor supply this industry has not been developed. General farming is practiced on this type and yields are comparatively low. Farms on this soil sell for $25 an acre on the average.

The Miami gravelly sandy loam has a rough and broken surface, some of it being too steep to cultivate. While devoted to general farming, it is difficult to cultivate on account of the gravel, stones, and steep slopes, and the yields are low.

The Miami fine sand, Miami fine sandy loam, Miami stony loam, and Clyde sand are all soils of small extent and of minor importance. In yields, adaptation to crops, and value of farms the Miami fine sand compares favorably with the Miami sand, while the Miami fine sandy loam is about equal to the Miami sandy loam. The Miami stony loam is a somewhat lighter soil than the Miami loam, and its surface is rough, broken, and covered with stones and bowlders.

Muck, which consists of thoroughly decomposed vegetable matter, occupies the low swampy areas and old lake beds, large portions of which have been reclaimed by open ditches. The peppermint industry has been developed on this reclaimed swamp land.

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U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

SOIL MAP
MICHIGAN
CASS COUNTY SHEET

MICHIGAN AGRICULTURAL EXPERIMENT STATION
C.D. SMITH, DIRECTOR
GEOLOGICAL SURVEY OF MICHIGAN
ALFRED C. LANE, STATE GEOLOGIST

SOIL PROFILE
(3 feet deep)

- Miami stony loam: L / L
- Miami gravelly sandy loam: Sl / Sl
- Miami sand: S / S
- Miami fine sand: Fs / Fs
- Miami sandy loam: Sl / S
- Miami fine sandy loam: Fsl / Fsl
- Miami loam: L / Hl
- Clyde sand: S / S
- Marshall loam: L / Hl

LEGEND
L Loam
Sl Sandy loam
S Sand
Fs Fine sand
Fsl Fine sandy loam
Hl Heavy loam

LEGEND
- Msl Miami stony loam
- Mg Miami gravelly sandy loam
- Ms Miami sand
- Mf Miami fine sand
- Ml Miami sandy loam
- Mfs Miami fine sandy loam
- L Miami loam
- C Clyde sand
- Ma Marshall loam
- Me Meadow
- M Muck

R. 16 W. R. 15 W. R. 14 W. R. 13 W.

T. 5 S. T. 6 S. T. 7 S. T. 8 S.

SILVER CREEK | WAYNE | VOLINIA | MARCELLUS
POKAGON | LA GRANGE | PENN | NEWBERG
HOWARD | JEFFERSON | CALVIN | PORTER
MILTON | ONTWA | MASON

DOWAGIAC · Cassopolis · Sumnerville · Pokagon · Edwardsburg · Adamsville · Volinia · Wakelee · Prairie Ronde · Marcellus · Vandalia · Williamsville · Brownsville · Redfield · Barron · Cushing · Glenwood · Charleston · Dailey · Jones · Corey · Union · Sailor

Scale 1 inch = 1 mile

Soils surveyed by W.J Geib 1906.

Field Operations Bureau of Soils 1906.